GLASSY FIR.

BY HERMANN VON SCHRENK.

During the past winter some specimens of wood of the balsam fir (*Abies balsamea*) were received at the Missouri Botanical Garden, which showed peculiar smooth spots at various points on cross sections. Two views of pieces of wood of this character are shown on plate 20. It will be noted that the sections there shown present a rough appearance, usually found when pieces of wood are cut with a cross-cut saw. There are certain irregular areas, however, which are perfectly smooth and shiny, as if they had been planed. Some of these areas extend out from the heart to the sap wood, while some of them form irregular circumscribed spots, one of which shows prominently on the lower figure of the plate. In all of the specimens sent in, the sap wood had the same appearance as the irregular smooth spots. A careful examination made with a hand lens showed no signs of decay in these smooth areas, nor could they be distinguished in any way from balsam fir wood, after it has been planed with a sharp plane.

The specimens were sent from the forests in southwestern Maine, in the region of the Androscoggin River. A good deal of balsam fir is cut in that region for pulp wood. Some of the balsam fir logs were rejected because of the "glassy" or "icy" appearance. It was claimed by some that the glassy appearance indicated a defect in the wood. From information obtained it is apparent that this glassy appearance shows itself in the balsam fir quite regularly during the winter months. It occurs both in old and young trees and apparently, as far as outward appearances go, in perfectly sound wood.

A microscopical examination was made of the glassy areas, and the sections so made were compared with sim-

ilar ones obtained from the roughened areas. To all intents and purposes, the sections from the two different regions were perfectly alike. There was no sign of fungus attack in the glassy regions, the cell walls were perfectly normal in thickness and color, and, in fact, the wood from the glassy regions could not be distinguished from that in the rough areas. In seeking for an explanation of the peculiar appearance of the wood, it was found that most of the glassy areas surrounded the healed-over portions of old branches, or they were at any rate near such regions. Where these areas were isolated they were generally near some check. In all cases, the sap wood had the glassy appearance.

All of the specimens examined were cut during the months of February and March, in other words at a time when the temperature in the Maine forests is 32° Fahrenheit, or generally very much lower. The following explanation was finally adopted as explaining the peculiar glassy appearance. It is very probable that during the months of February and March, the water present in the trees was frozen, and that all cells that had water in them were then filled with solid ice. When the trees were cut down by means of a saw, the teeth of the saw tore the fibres of the spring wood, giving the appearance of roughened areas, usually seen when a soft wood like the balsam fir is cut with a saw. Wherever these wood cells were filled with ice, however, the latter acted as a reinforcing material, and when the saw cut through the fibre, enclosed on all sides by the solid ice, the fibres were not torn as is usually the case. The result was that when the sawing operation was complete, those areas which were filled with solid ice presented a smooth appearance. The ice, in other words, acted very much in the way any imbedding material like collodion, paraffin, etc., acts in sustaining weak cell-walls during the operation of cutting sections with a knife.

In order to test this theory, sections were made with a

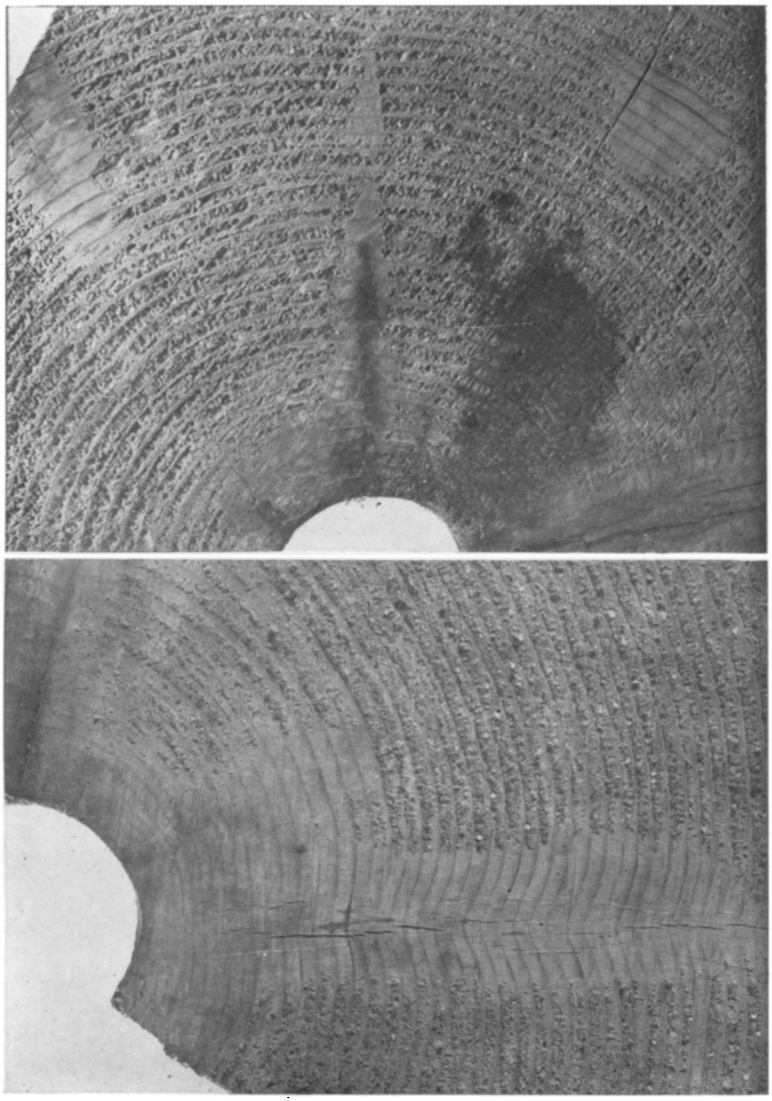
sharp saw through several of the blocks of wood, cutting both through the glassy area and the roughened area. These sections were so made that the point at which the cut was made was not more than one-quarter of an inch below the glassy surface. In all cases the surface was rough over its entire extent, irrespective of whether it was an isolated glassy spot, or the rough wood.

In order still further to see whether the smooth appearance of the wood was due to freezing, several pieces of loblolly pine (*Pinus taeda*) were boiled for several hours in water so as to thoroughly water-soak them. The pieces were chosen from specially wide-ringed trees. After the soaking, the pieces were laid out of doors, and were allowed to freeze thoroughly. The thermometer during the particular night when they were exposed was below zero. The following morning the pieces were sawed half way through while in the frozen condition, the section being made about an inch from the outer surface. An ordinary cross-cut saw was used for the purpose. The pieces were then brought into the laboratory, where they were allowed to thaw out completely. After some 10 hours the section which had been partially sawed off in the frozen condition was completely cut off. In other words, one-half of the section was sawed while in the frozen condition, and the other half after the wood had thawed out. On plate 21 a photograph of one of the sections is reproduced. The part on the upper side of the figure was the portion sawed while the wood was frozen; the lower half, after the wood had thawed out. It will be noted that there is a marked line of demarcation between the two parts, the frozen part being smooth, the other half showing the rough surface usually found when a pithy wood of this character is cut with a cross-cut saw.

Similar tests were made with red fir and white spruce, and in all cases the peculiar glassy appearance was obtained in the frozen portion of the wood.

The result of these experiments seems to prove conclusively that the smooth appearance of certain of the areas is probably due to the reinforcing action of the ice which filled the wood cells. The peculiar distribution of the glassy spots along the lines of former branches, or at least close to them, becomes readily intelligible when one remembers that the lowering of temperature is more likely to take place along such channels as are in communication with the outer portions of the tree trunk. Many of the branches are frequently in direct communication with the outside air. In cooling, the first part of the tree in which the water would probably freeze is the part immediately under the bark, that is the sap wood. This, as has been stated, has a uniform glassy appearance in all the specimens. The lowering of temperature would then gradually proceed inward. It would take place most rapidly along radial channels such as the older branches. The presence of liquid water in any of the cells is another factor to be considered. As a rule, the heart wood of a tree like the balsam fir usually has very little liquid water in the cells, most of it being held by the cell walls. It is very well conceivable that there should be more water, first of all, in the sap wood and again in the healed-over branches. Isolated spots like the one shown in the upper right-hand corner of the upper figure of plate 20 may be explained by the fact that certain portions of the wood, for reasons not yet clear, frequently have a higher water content than the wood mass at large. Where such quantities of water occur, it would be possible to get smooth spots of the character referred to.

From a practical lumbering standpoint, the glassy fir should be regarded as in no way defective. Further studies concerning this appearance are in progress and will probably throw more light on the conducting capacity for heat of various portions of a tree trunk.



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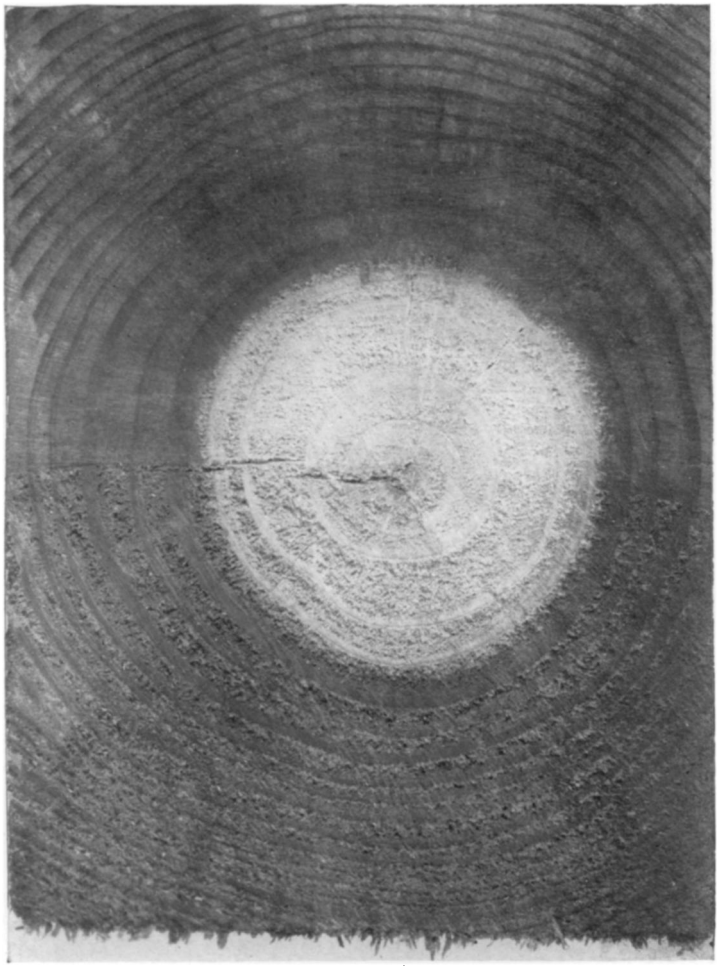

FROZEN LOBLOLLY PINE.